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PROCEEDINGS

OF

THE ROYAL IRISH ACADEMY.

MONDAY, APRIL 11, 1864.

WILLIAM HENRY HARDINGE, Esq., in the Chair.

Alexander M'Donnell, Esq.; J. J. Lalor, Esq.; the Hon. Thomas D'Arcy M'Gee; and Sir Victor A. Brooke, Bart.; were elected members of the Academy.

The Secretary read the following paper, by ALEXANDER MACALISTER, L. R. C. S. I., Demonstrator of Anatomy, Royal College of Surgeons:—

ON THE ANATOMY OF THE OSTRICH (*STRUTHIO CAMELUS*).

THE science of comparative anatomy requires for its basis the records of the careful and minute dissections of at least the typical forms of the animal kingdom, in order that we may arrive at correct ideas regarding the proper homologies and relations of the various parts of which the animate frame is made up; and though the subject of this memoir has been examined very frequently, there does not exist, to my knowledge, a complete or accurate account of its structural peculiarities. M. Perrault has left on record the dissection of eight of these birds; but in his description many interesting facts regarding the visceral anatomy are not mentioned, and the muscular system is not at all described. During the past year the splendid pair of ostriches belonging to the Zoological Society of Dublin died—the female in June, 1863, from the constitutional disturbance consequent on a compound fracture of the metatarsal bone of the left leg; the male in January, 1864, from the effects of the severe and unexpected frost: both these animals have been dissected with great care, and many novel points of anatomical and physiological importance have been ascertained in their structure.*

* The female ostrich was dissected in the Museum of the Royal Dublin Society, and the male ostrich in the dissecting rooms of Trinity College. I am indebted to Dr. Carte and to the Rev. Professor Haughton for the opportunities I had of assisting in their anatomical examination.

They were both full grown and in good condition, the male being rather taller and fatter than the female. The integument, when removed, does not present the remarkable series of cutaneous muscles seen in the *Apteryx*; but a large number of superficial veins are discernible passing around the roots of the feathers. The skin varies in thickness in several localities, but in general is strong and dense; on the neck it is tough and thin; on the breast and pubis it presents two callosities of considerable size, on which the animal was in the habit of resting; on the dorsal aspect the tegument is thick and strong, and clothing the metatarsal bones it presents a series of large flat scales. Beneath, on the sole of the foot, the surface of the skin presents a series of closely set bristle-like processes, invested with a hard horny epithelium; these are about one-fifth of an inch in length, and would seem to serve in facilitating the transit of the animal over the sandy soil of the desert.

Under the skin is a fatty superficial fascia of very great thickness in some situations; over the abdomen in the female this adipose layer was two and a half inches thick, diminishing in thickness over the thorax, and ceasing altogether downwards on the thigh. The integuments and fat are closely connected to the bone over the sternum, in the region of the callosity, where the fatty matter has a granular appearance, similar to that on the sole of the human foot. This fatty layer is permeated by many very large veins, some of which can be traced to the pulp of the feathers. A thin and distinct layer of fascia separates the adipose structure from the muscles underneath, which were three in number—external oblique, internal oblique, and transversalis. The former arises from the lower borders of the ribs, and from a fascia which extends upwards to the vertebral column, and backwards to the brim of the pelvis; the fibres pass downwards and inwards to the mesial line, into which they are inserted for its whole length. The internal oblique, underneath the last, arises from the borders of the pelvis and lumbar fascia, runs forwards and inwards to the same insertion. The transversalis commences by a strong flat aponeurosis from the spine and lower border of the last two ribs. This structure becomes fleshy for about two inches, and then forms an anterior tendon, which is inserted into the linea alba as far down as the symphysis pubis. The expanded tendons of these muscles attached to the spine form a strong lumbar fascia.

Beneath these muscles lies an enormous fatty cushion, an inch and a half in thickness, and highly vascular; Perrault describes this as intervening between the abdominal muscles, but in reality it lies posterior to them, and immediately over the peritoneum, which in our female bore the marks of inflammatory action, and exhibited extensive subja-cent ecchymosis.

On the wall of the thorax are found two layers of intercostal muscles, separated by the intercostal vessels; the external run downwards and forwards, and cease at the spurs of the vertebral ribs; the internal pass in a contrary direction, and only extend for three inches behind the spur on the vertebral ribs. A series of triangular levatores costarum pass from these spurs to the ribs below, extending as far forward as the articulation between the sternal and vertebral ribs; these and the internal

intercostals are in contact with the serous membrane lining the thoraco-abdominal cavity. The sternal ribs articulate with the vertebral by means of arthrodial surfaces, united by capsular fibres and a central inter-articular ligament. On laying open the abdominal wall we disclose the viscera. The stomach is continuous with the lower end of the œsophagus, which exhibits at its lowest point a gradual dilatation, with no distinct proventriculus: this organ is placed obliquely, so that the cardiac orifice is on a plane inferior to the pyloric. The whole organ is an elongated oval in shape, and is not constricted in the centre; the thickness of its walls varies considerably,—the cardiac extremity being thin and membranous, the pyloric an inch and a half thick, and made up of alternating laminae of muscle and tendon: *its epithelial lining is thick and soft, very loosely attached, except in the vicinity of the pyloric orifice, and much corrugated, the rugæ being small, and arranged lineally in the long axis of the organ at the cardia, but larger and more irregularly convoluted at the pyloric extremity.* This membrane has a decidedly acid reaction with litmus paper. The succenturiate gland is dumbbell-shaped, one broad extremity being placed at the cardia, and the other towards the pylorus; it measures four inches at its widest part, two at its constriction, and twelve in length; its orifices are arranged quincuncially, twenty-five to the square inch, and each communicates with a racemose gland. The pyloric orifice is much smaller than the œsophageal, and is semicircular in shape, its straight border being formed inferiorly by the tendinous wall of the gizzard; the curve is formed of alternate firm ridges and grooves, the former six in number, the latter seven, and by this apparatus the passage of undigested materials is retarded; this orifice is situated anteriorly, and between two radiating tendinous laminae. All the substances contained in the stomach were of a dark green colour, as also was its epithelial coat; its contents were vegetable matters and stones in large quantities—the latter were rounded and worn.

In the outer coat of the stomach of the female, and in contact with the gastric artery, a pin was found, enclosed in a cyst. The intestinal canal seems to vary much in length. Hunter records finding it 70 feet, while Perrault, in his eight, states that it varied from 50 to 42, 33, and even to 29 feet; in our female the intestine measured 42 feet, and in the male 44 feet. The duodenum commences at the pylorus, is about three feet long, and passes very nearly in the course described by Hunter, first downwards, then turning and folding on itself, then passing from left to right, then ascending till it crosses the spine above the ovaries in the female, and is retained in its place by piercing through the root of the mesentery; at first, about three inches from its beginning, it receives the hepatic duct, and three feet lower the pancreatic. From the situation where it escapes from traversing the root of the mesentery it is accompanied downwards on either side by a spiral-valved cæcum, which is enclosed in the same layer of peritoneum, and lies about an inch distance from the gut; about $2\frac{3}{4}$ feet below, these cæca unite with the intestine, and from thence the colon passes downward rather narrower than the upper intestine; its surface presents valvulae conniventes like those in the small intestine of man, which are arranged alternately on

each part of the intestine, and pass three-fourths round the tube, projecting half an inch inwards. These elongate the mucous surface over which the food passes. This portion of the intestine was filled with hard faecal masses, containing whole corn and undigested food. The lowest part of the rectum passes from the right side downwards, and opens into the same side of the cloaca, inclining a little to the left; it projects into this sac for about half an inch, and is surrounded by a strong sphincter muscle embedded in its everted lip. The mucous membrane is longitudinally plicated, and the anus can be dilated to a considerable extent. The longitudinal fibres of the rectum are very distinctly marked, especially near its termination. The folds of peritoneum which enclose the intestine are three in number: first, a short process which holds the duodenum in its place; secondly, a mesentery, in which is enclosed the intestine and caeca; and, thirdly, the portion which surrounds the lower intestine; this latter extends across the spine obliquely from above, downwards, and to the right. In the second fold the mesenteric artery is traceable, and the lacteals, which pass upwards and backwards, and form a thoracic duct, which is seen to pass behind the venæ cavæ, and internal to the upper part of the right kidney, and to the right of the aorta; all these folds lie superior to the ovaries.

The cloaca in the female is a large sac, admitting readily the whole hand; from its left side passes the oviduct, which is a large dilatable tube, capable of receiving four fingers and exhibiting longitudinal plicæ on its mucous membrane; on the right side, and in a corresponding position, is a small cæcal depression, but no duct. To the right of this and posteriorly the rectum opens at the top of the cavity, and between this aperture and the oviduct the mucous membrane forms a large crescentic fold, its concavity looking downwards and backwards towards the external orifice; this appears to be capable of shutting off the rectum during the passage of an ovum, and *vice versâ*. Behind the rectum and oviduct, in a small posterior pouch, open the two ureters very obliquely, one on either side, about an inch and a half apart, each admitting the little finger at their opening, but diminishing rapidly as they ascend; they are separated by a strong median ridge.

Into the outer margin of the cloaca a strong levator cloacæ muscle is inserted, which passes down from the posterior part of the sacrum and from the ischiatic ramus. A strong sphincter, an inch in breadth, encircles the external opening. In the centre on the upper surface is a small pendent of cellular and erectile tissue, or clitoris, which displays a dorsal groove. The mucous membrane of the cloaca is arranged in longitudinal plates, so as to facilitate distention.

In the lower part of the abdominal cavity in the female existed about two dozen ova, each enclosed in a separate sac or calyx, and all attached by a common pedicle about two inches thick to the posterior wall of the abdomen; by this the vessels pass into the ova, and ramify on the surface in a pectiniform manner, forming a vascular zone or girdle, the stigma of the ova. One of these ovaria, that had emitted its egg a few days before the animal's death, appeared collapsed and dark coloured; the others were light and yellowish, and from the size of a pea to that

of a large teacup. To the left side, and attached by a long distinct layer of peritoneum, in which are contained many arborescent vessels, lies the oviduct, beginning above by a bilobate, soft, gelatinous orifice in the peritoneal fold enveloping the ova, and descending and gradually widening into a large ovisac; the whole tube is $2\frac{3}{4}$ feet long and opens by a narrow but dilatable orifice into the cloaca below. The interior of the lowest part was very gritty in feel, from the particles of carbonate of lime secreted there for the formation of the shell. The lowest part of the ovisac has a strong, well-developed muscular coat, which diminishes and almost ceases at the upper part.

The kidneys are elongated, flattened, glandular masses, thirteen inches long, and an inch and a half wide, lying deeply seated, and extending from the posterior edge of the diaphragm to the anterior extremity of the pelvic cavity; they are brownish-red in colour, rough on the surface, and the left is divided into two lobes; each is bordered by a large vein, which passes up to join the cava, posterior to which the ureter arises, at the junction of the inferior and middle third, from a well-marked pelvis, into which open several infundibula, which can be traced back to calyces. The medullary matter is not arranged in pyramids, nor do its tubes converge to papillæ. The ureter passes down approaching the mesial line, is reddish-white in colour, and cylindrical in shape. The renal artery is a branch of the aorta, and enters posterior to the ureter. The kidney is enveloped in a fatty capsule, which is very dense in front, and binds it down in its place, separating it from the ovaries. The supra-renal capsule is at its upper part, flattish-oval in shape, three inches long, and deep orange in colour; its inner angle passes considerably farther back than its external, and its upper surface is in contact with the diaphragm. There is no distinction of cortical and medullary matter in its structure. Superior to the kidney, on the left side, lies the spleen, enclosed in a layer of peritoneum derived from the stomach, and elliptical in shape, narrower above than below, the long axis being directed downwards, forwards, and to the right side; it is three inches and a half in length by one in breadth; it is surrounded by a capsule of peritoneum, and by a proper fibrous coat underneath; it is supplied by a branch of the cæliac axis, and is made up of a soft, spongy, vascular tissue of a deep red colour.

The generative organs of the male consist of two testes, placed above and a little external to the kidneys, invested in a strong fibrous tunica albuginea, about three inches long and $1\frac{3}{4}$ inches in width; from the outer and back parts of these organs, the tubes pass to form a large epididymis, which is prolonged for three inches below the testis, and narrows into the reddish soft vas deferens, which runs down almost parallel to the ureter, and opens into the cloaca a little external and anterior to it; there is an elongated and pointed eminence, more than a quarter of an inch long, seen on the mucous membrane of the cloaca, and at the apex of it is the orifice of the vas; the opening of the ureter is much smaller in the male than what it is in the female. The two vasa deferentia open on either side of the groove in the intromittent organ, which commences by two firm fibrous crura attached to the pubis, then turns

downwards and backwards; when retracted, this organ lies at the bottom of the cloaca, curved; it has two muscles inserted into it, one at either side, which would serve to compress its texture. The dorsal groove terminates at its apex, where the investing membrane is red, and covered with a large number of sentient papillæ. There are inserted into the cloaca a pair of long round muscles on either side, which do not appear in the female, and which are attached to the rami of the pubis. A very strong sphincter guards the orifice of the cloacal sac.

The pancreas is about ten inches long, and is included between the first two turns of the duodenum, and surrounded by peritoneum; in colour it is pink, and is very soft, loose, and granular in texture; from its centre passes the pancreatic duct, which commences in the gland by two branches, which unite before it passes from the gland substance; its duct opens into the second fold of duodenum, nearly three feet from the hepatic.

The liver consists of two nearly equal lobes, the right being prolonged a little lower down than the left; these lobes are separated above by the vena cava, which grooves the organ; a falciform ligament also exists on the upper surface. The right lobe in the female exhibited an extravasation, and the capsule was very easily separated. No gall bladder existed. A small quadrate lobe exists behind the notch for the apex of the heart, and still farther back the outline of a Spigelian lobe is visible, separated from the former by a short transverse fissure, to which the lesser omentum is attached, and behind which is a large oval opening or foramen of Winslow. Through the transverse fissure the vena porta from the intestines passes upwards, and to the right a small branch or lesser porta pierces the left lobe. In front and to the left emerges the duct, which begins by three small branches, and passes behind the duodenum to the right, opening, three inches below the stomach, into that intestine. The liver has two lateral ligaments, and many vessels ramify between the layers of the left.

The large abdominal veins commence in the pelvic cavity, and pass forwards, one on either side, along the kidneys, grooving them as far as the middle of these glands, and lying about an inch apart; in this situation they bend inwards and unite, and then separate almost immediately, so as to form the figure of X; they still border the kidney, and unite at the upper edge of these glands, where the left one, the larger, passes over and joins the right; the vessels previous to this union receive the external iliac veins, and the femorals, which are separated from the femoral arteries by the kidneys, the latter vessel lying posterior.

The cava ascends inclined a little to the right, comes in contact with the lower border of the liver, and passes in the sulcus between the two lobes, then receives the *venæ cavæ hepaticæ*, and ends above in the right auricle.

In the thoracic portion of the somatic cavity the heart is seen in the centre, contained in the pericardium, a conical sac, the apex of which is very acute, and is directed downwards, and surrounded by the liver, between the lobes of which it lies. This fibro-serous membrane is con-

nected posteriorly to the diaphragm, but partially separated from it by the cesophagus : on laying it open, the heart is exposed, with the great vessels starting from it. On the surface of the organ are seen the two coronary arteries, one arising behind the infundibulum of the pulmonary artery, and passing first between the left auricle and ventricle, then between the two ventricles anteriorly ; the other, arising from the aorta, opposite the right side of the pulmonary artery, and passing in the posterior auriculo-ventricular sulcus, supplies the back of the heart, anastomosing with the last at the apex.

The right auricle is a medium-sized cavity, with well-marked vertical muscoli pectinati in its wall, and no appendix. The inter-auricular septum is thick, and separates the right from the smaller left auricle, which also presents strong perpendicular muscular bands on its wall, and is likewise devoid of an appendix. The two pulmonary veins unite and open into this cavity, on its posterior wall, by one common aperture, which is surrounded by a strong muscular band, which would be competent to close the orifice in a valvular manner. To the outer surface of the auricle several fatty masses are appended, like the appendices epiploicæ of the intestines.

The right ventricle is a three-sided pyramid in shape when distended, smooth inside except around its edge, where there are a series of muscular trabeculæ ; its auricular orifice is oval, about $1\frac{1}{3}$ inch in its long axis, and guarded by a strong muscular valve, $1\frac{1}{2}$ line thick, situated to the right of the foramen, and extending for two-thirds around it ; a strong muscular band unites this to the anterior wall of the cavity, and strengthens its attachment. Numerous foraminæ Thebesianæ exist on the inner surface of this cavity. The orifice of the pulmonary artery is about two inches from the right auriculo-ventricular opening, and is guarded by three semilunar valves with indistinct corpora Arantii, and having large sinuses of Valsalva behind them.

The left ventricle is strong, its wall being thirteen lines thick in several places, near the apex, however, it is extremely thin, in one spot only measuring two lines. The left auriculo-ventricular opening has a strong zona tendinosa and three membranous valves attached by cordæ tendineæ, but without distinct muscoli papilares connected to them : carneæ columnæ are apparent near the apex of this cavity, but are not connected to the valves. The cordæ tendineæ are very numerous, and pass transversely outwards from the walls of the cavity to the valves, the curtains of which are situated right, left, and posterior ; the first is the largest, and is placed half an inch from the auricular opening. The aortic orifice presents nothing peculiar, but is protected by three semilunar valves. Longitudinal rugæ were visible in the lining membrane of the aorta in the female ostrich, with patches of atheromatous deposit.

The aorta passes from its origin to the right side, and then curves backwards and to the left ; this arch ascends for a very short distance, and about an inch above its origin from its convexity it gives off two arteriæ innominate, right and left, the latter being on a plane anterior to the former, and both lying on the trachea, in front of which and above the aorta lies a large round air cavity, about two inches and a half in

diameter, lined by a smooth cellular membrane, invested with a layer of epithelium, and presenting no distinct opening into it. The right innominate artery is about two inches and a half in length, forming a curve concave to the right; it gives off the carotid and subclavian branches, the latter being small and passing outwards, the former ascending.

In connexion with the carotid artery is a large, brownish, glandular mass, about an inch in diameter, supplied by many arteries, and emitting a large number of veins: this and its fellow of the left side are the lateral lobes of the thyroid body without an isthmus. The left innominate is similar to the right in most respects. From the commencement of the subclavian a small cervical branch—the vertebral—passes upwards into the posterior portion of the neck. The pulmonary artery arises from the infundibulum of the right ventricle, is about two and a half inches long; and one inch and a half in diameter; it passes upwards, backwards, and to the left, and then divides into right and left branches. The trunk lies in front of the aorta, and its bifurcation corresponds to the front of the termination of the trachea. The right branch passes through the grasp of the arch of the aorta, is rather smaller than the left, runs downwards, backwards, and to the right side, lying above the right bronchus. The cardiac nerves of the right side run parallel to its upper border as far as the anterior part of the root of the aorta, where they end in forming the coronary plexuses to supply the muscular substance of the heart. The left pulmonary artery is larger, more anterior, and superior, than the right, but nothing of importance is discernible in its course. The great veins are three in number—two superior cavæ, and one inferior: the left superior cava is formed by the union of the jugular and subclavian veins with several smaller vessels from the thoracic parietes. This vessel lies posterior and external to the sterno-tracheal muscle, and internal to the furculum. The length of this vein before it is joined by the azygos is three inches, and this latter vessel unites with it just as it is passing into the pericardium, and an inch and a half from its entrance into the auricle. This vein runs downwards, backwards, and to the right side. The left vena azygos begins in the abdomen, at the upper border of the ovaries, passes over the diaphragm, and runs obliquely on the side of the pericardium, behind the left lobe of the liver, and terminates in the left superior cava. The right superior cava is double the size of the left, with which it corresponds in many points, its orifice being separated in the auricle from the inferior cava by a membranous valve, the great Eustachian, which guards the mouth of the latter: as this vessel is passing downwards, and to the left side, it receives the right vena azygos, a very small vessel, scarcely admitting an ordinary probe, which passes between the pleura and pericardium on the right side, and passes behind, and to the right of the auricle. The pulmonary veins are two in number, one on either side; the left is the longest, and is placed below the bronchus, and was in the female plugged up by a firm fibrinous coagulum. These vessels coalesce as they approach the auricle.

When these various organs are removed, a complex system of septa is exposed; of these there are five portions—one transverse, a

fibrous structure, formed mainly of a fold of peritoneum, is placed across between the liver and the heart above, and the stomach and spleen below. This fold is attached anteriorly and inferiorly to the lower edge of the sternum, and it unites with the tendinous lamina of the transversalis; behind, this lamina is united to the diaphragm proper, which we shall describe subsequently. This portion is not, however, a complete septum. On removing the liver and heart, two large fibrous laminae are exposed, covering the very large air sacs, which occupy a large part of the thoracic cavity; these laminae send in four septa on either side, so as thus to subdivide the lateral portions of the cavity into four compartments; but the divisions are extremely loose and fibrous, so that each compartment freely communicates with its neighbour. In the centre of these compartments existed several peculiar oval bodies, like lymphatic glands in appearance, and in structure composed of an external rough, firm, fibro-cellular coating, with an internal yellowish-brown matter of sebaceous consistence. These were about an inch long, three-fourths broad, and one-fourth in thickness, and were arranged in a line on each side, connected to the septa by ten or twelve threads, radiating in all directions. Beneath these bodies and the air sacs, we find a true muscular diaphragm, composed of a flat tendinous central lamina, and two lateral fleshy portions, concave in front and below, convex above and behind; it is attached on either side by five fleshy slips to the five lower vertebral ribs along their margins; the fibres run backwards and inwards to the tendons, and some pass a little upwards, and are about $2\frac{1}{2}$ inches in length. The kidney reaches to its lower border, and the spleen lies on its inferior and posterior surface. The œsophagus pierces it in front, and lies below it for a considerable distance; the two lower muscular fasciculi are separated from the upper by a large aperture, looking downwards, forwards, and outwards, which led to the air sac from the bronchial tube. Two other large openings exist, one on either side of the œsophageal orifice, which pass downwards and backwards; and above, and external to these, are two smaller holes, running in the same direction; the two lower slips of muscular fibres are broad and flat, and the upper are round and thick. The aorta passes through the lower border of this true diaphragmatic structure, and on either side of it passes down a tendinous slip or crus, to be attached to the sides of the bodies of the lumbar vertebræ.

The lungs are exposed on removing the diaphragm, and appear placed at the upper and back part of the cavity of the thorax, filling the spaces around the heads of the ribs; into these organs pass the bronchial tubes, one along the centre of each lung towards the base, the right being more transverse and more curved than the left. These tubes are membranous, and communicate with the air sacs by means of the openings in the diaphragm; all its branches come off in a regular series from its posterior surface, and the trunk ends below by communicating with a large air sac, which lies on either side of the back of the abdominal cavity; this latter is similar in structure to the thoracic series of air cavities. The branches of the bronchus appear pinkish, and seem mus-

cular, and are arranged in a row of eight or nine large holes, with an alternate series of smaller holes externally; a double row exists on the right, but a single series on the left. The air sacs communicate with these bronchi. The lungs are separated from each other by the aorta, which passes down inclining to the right side, and pierces through the diaphragm opposite the lowest border of the last thoracic rib; a tendinous arch passes over it at this point, below which the cœliac axis arises. This trunk is about $1\frac{1}{2}$ inch long, and gives off gastric, hepatic, and splenic branches; around it is arranged a sympathetic solar plexus, and from its root start the diaphragmatic arteries. The superior mesenteric artery arises an inch below and to the right of the last, and supplies the intestines. The femoral artery arises from the aorta, three inches below the superior mesenteric; it is a small trunk, runs outwards, and divides into a proper femoral and an external iliac, which passes along the brim of the pubis as far as the symphysis; below the origin of this vessel the aorta, or sacra media, continues downwards behind and between the kidneys, and immediately behind the vena cava, from which it is separated by a delicate fascia. A large sciatic branch passes off through the sciatic notch, and accompanies the sciatic nerve, becoming popliteal behind the knee; still lower, a series of renal vessels arise on either side, and from the anterior aspect of the aorta the ovarian vessels of the female start. At the lower border of the kidney the aorta bifurcates; each lateral branch, about two inches lower down, again divides into two, which again split in a similar manner, so as to form a series of eight tertiary branches, which terminate, behind the cloaca, in the pad of the tail, for the nutrition of the plumes.

In the neighbourhood of the tail there exist the following muscles:—*Levator coccygis*, which arises from the lower part of the sacrum, about two inches in extent; the fibres pass downwards and backwards, forming a series of roundish muscular fasciculi, which are inserted by round tendons into the seven caudal vertebræ as far as the last. Between this pair of muscles are seven depressions, corresponding to the foramina in the vertebræ. *Coccygæus* arises from the side of the lower half of the coccygæal vertebræ, forms a triangular mass, running to be inserted into the pad of the tail. There is no sign of an oil gland in this locality. *Depressor coccygis* is a small muscle, passing from the bodies of the upper to the last caudal vertebræ.

The muscles of the back form a small and not very distinctly developed series. On raising the integument and fat, we bring into view the first or *latissimus dorsi*, which arises tendinous from the spines of the three or four upper dorsal vertebræ. The fibres run downwards and outwards, to be inserted into the inner edge of the upper third of the humerus and fascia of the wing.

Rhomboideus major, beneath this, arises from the fascia at the upper and back part of the thoracic wall, passes forward to be inserted into the blade of the scapula along its posterior border.

Rhomboideus minor is above the last, and has a tendinous origin from transverse process of the last cervical vertebra, from which it passes

downwards, and is inserted into the scapula above the last named. Beneath these rhomboids exists a deeper muscle, also of a rhomboid shape, which is attached to the necks of the first and second ribs, and is inserted near the point of the blade of the scapula.

Serratus is a small, thin, square muscle, arising by an aponeurotic expansion from the lower edge of the upper ribs; the fibres pass downwards and backwards, and are inserted into the anterior border of the scapula, below the origin of the *teres minor*.

Semispinalis dorsi, or *sacrolumbalis*, arises from the upper border of the posterior portion of the crest and dorsum of the ilium, and from the sides of the lower vertebræ, by fleshy fibres, which pass forwards and a little outwards, to be inserted into the angles of the five upper ribs by tendinous and fleshy fasciculi. Lying internal to this we find the *longissimus dorsi*, attached below to the posterior and inner half of the crest of the ilium, and to the sides of the lumbar vertebræ; the muscle runs upwards and forwards, and at the lower part of the neck divides into several fasciculi, which run to be inserted into the sides of the transverse processes of the four lower cervical vertebræ: the most internal band continues upwards, to be attached to the five or six upper cervical transverse processes, and to a pit above the foramen magnum on the occipital bone. This muscle seems to consist of several portions which in other animals are distinct.

Levatores costarum posteriores, seven in number, arise tendinous and fleshy from the transverse process of the seven upper dorsal vertebræ, and run outwards and backwards, to be inserted into the outer surface of the ribs as far as the angle; their action is to elevate or fix the vertebral ribs. *Spinalis dorsi* passes from the lower to the upper dorsal spines, but seems not to be attached to any regular number of vertebræ.

Scalenus—a small triangular mass—arises from the posterior tubercle of the transverse process of the last cervical vertebra, and is inserted into the upper border of the first rib, close to its vertebral articulation.

Multifidus colli consist of many slips, which pass from the anterior tubercles of the transverse processes on the sides of the cervical vertebræ to be inserted into the prominent tubercle on the middle of the anterior aspect of the body of the vertebra above. There is also a posterior set of these muscles, which run from the posterior tubercle of the transverse process of each vertebra to the spinous process of the vertebra above.

A thin *biventer cervicis* may be found, arising by an aponeurosis from the dorsal vertebræ, and inserted along with the *longissimus dorsi*. On the front of the thorax, the great pectoral is seen—flat, thin, fleshy, and triangular—arising from the outer edge of the sternum and the three upper sternal ribs, and passing outwards to be inserted into the ridge on the upper and outer parts of the humerus below its head.

When the integument is removed from the face, a series of facial muscles are exposed, principally connected with the eye, which is guarded by two nearly equal lids, whose edges are beset with stiff, everted hairs, longer on the upper than on the lower lid. Transverse fibres run into the substance of the lower lid, like the remains of an orbicularis

palpebrarum, the use of which seems to be, to elevate the lower lid ; posterior and superficial to it is a venous plexus, formed of the veins of the head and face uniting to form a single trunk, which passes to the jugular vein. A strong palpebral ligament extends from the brim of the orbit all round into the lid, to strengthen it. Levator palpebræ superioris arises within the orbit, from the bony surface forming the posterior portion of the roof of the cavity ; the fibres run outwards, and are inserted into the tarsal border of the lid. A small anterior bundle of muscular fibres passes from the inner or anterior angle of the orbit to the inner canthus of the lids ; this seems to be also an elevator of the upper lid.

The orbit contains the recti, obliqui, and the two muscles of the membrana nictitans : the former arise around the border of the optic foramen, united by a ligament of Zinn, stronger above than below. The muscles of the membrana nictitans are, as usual, quadrate and triangular ; nothing of peculiarity is noticeable in their arrangement, except that from their greater size they are better seen than in most birds. They are supplied by the third nerve, and the tendon of the triangular muscle grooves the sclerotic posterior to the bony plates. External to the triangular muscle, and between the inferior and internal rectus, is placed a large oval Harderian gland, embedded in cellular tissue, and compressed, probably by the triangular muscle when acting, so that its secretion is forced out, and is conveyed by a duct to the inferior and inner border of the attachment of the membrana nictitans. A peculiar gland is found embedded in the depression on the side of the frontal bone, separated from the nose by a strong membrane, through which its duct seems to penetrate. All the parts in the orbit are surrounded by the layers of a loose ocular fascia.

There are two elevators of the lower jaw, closely connected. Temporal arises from the deep fossa behind the orbit, and is inserted into the coronoid process of the lower jaw ; the other lies more horizontally, and arises posterior to the last from the hinder portion of the temporal fossa, almost as far back as the occipital bone ; from this origin it passes downwards and forwards, to be inserted into the ramus of the lower jaw in front of the coronoid process, here overlapping the last. A large glandular mass fills up part of the interspace between these muscles, in contact with the forementioned venous plexus.

In dissecting the neck, a large platysma is first seen, which below is attached to the furculum, and above to the integument, as high as the head ; its outer fibres are oblique, and the inner vertical ; it is thicker and stronger in front than behind ; beneath it, at the upper part of the throat, is the larynx and its muscular apparatus, and in our dissection we meet with the following :—

Mylo-hyoid—flat and triangular—arising from a ridge on the anterior four-fifths of the lower maxilla, in contact with the mucous membrane of the mouth ; the fibres pass inwards, and are inserted along with the opposite muscle into a median raphe ; a few of the most posterior are attached to the os hyoides.

Maxillo-keratic is a long flat slip, passing from the lower jaw a little

in front of its condyle, to be inserted into the concavity of the great cornu of the os hyoides, round which it winds. A small muscular slip runs from the great cornu of the os hyoides on one side to the opposite, probably acting as an approximator. Genio-hyoid—flat and straight—runs from the lower surface of the centre of the lower jaw, passing backwards to be inserted into the body and root of the great cornu of the os hyoides; beneath this pair is the upper quadrilateral projection of the os hyoides, continued into the very short tongue. Hyoglossus, a very short muscle, passes from the sides of the body of the os hyoides, as far forwards as to the tip of the tongue.

Numerous small muscular slips exist on the anterior aspect of the larynx: one—hyo-laryngeus—passes from the back of the os hyoides to the upper border of the thyroid cartilage, and several small transverse slips unite the cornua of the thyroid cartilage. Thyro-hyoid—small, transverse—passes from the oblique line on the front of the thyroid cartilage, to be inserted into the great cornu of the os hyoides. Sterno-tracheal—three feet and a half in length—arises from the posterior surface of the top of the sternum by a round muscular slip, which is reflected inwards on the side of the trachea, three inches above its bifurcation; from this point the muscle passes upwards, being adherent to the cartilaginous rings as it ascends, the fibres expand, and finally are inserted into the lower border of the thyroid cartilage, some passing as far as the os hyoides. On the side of the thyroid cartilage a small muscular slip passes to the back of the os hyoides. In the substance of the tongue a few longitudinal muscular fibres or linguales can be traced on either side of the middle line. The upper larynx exhibits two vocal cords, which are more than half cartilaginous. There is no epiglottis; the muscles seated here are principally the proper arytenoids and posterior dilator muscles; a pair of thyro-arytenoids may also be seen. There is no lower larynx. The trachea is made up of complete cartilaginous rings, forming a tube three feet nine inches in length, behind which lies the œsophagus, with a plicated lining membrane, which begins above in a dilatation or pharynx; on either side of the upper part of this sac lies a large glandular mass or tonsil, opening by several ducts, which communicate with racemose gland cavities. The jugular vein, which lies in front of the carotid artery, passes posterior and external to the œsophagus; the arteries lie close together, but do not communicate.

In removing the upper portion of the skull, in order to expose the brain, the bones are found extremely spongy, and united at the sutures. When they are removed, the encephalon is brought into view, invested with a dura mater, arachnoid, and pia mater. The former is strong, and does not present more than the rudiment of a falx; and the latter is found passing into the ventricles on either side, forming a choroid plexus. The cerebrum exhibits no convolutions on its surface, and is made up of two hemispheres and two tubercles or optic lobes. The cerebellum lies posterior and inferior to the cerebrum; and the medulla oblongata is a central prominence, exhibiting no secondary subdivisions, connecting the spinal marrow below with the encephalon above. The cerebellum consists of

one large central lobe, marked out into a series of transverse lamellæ by fissures or involutions; to either side of it small lateral lobes are appended, and in section it presents a distinct *Arbor vitæ*. No pons varolii seems to exist even in rudiment. The carotid arteries ramify on the surface of the organ, and the vertebrals pass on the side of the medulla oblongata. From the base of the brain pass the cerebral nerves. The first, or olfactory, runs to the nose, under a bony shelf, from the anterior and inferior portion of the cerebrum, where a small conical eminence is observable; it is extremely soft and somewhat greyish at its origin. The second, or optic, arises from the optic lobes, curves downwards and forwards, and meets in front of the infundibular fold of pia mater with its fellow of the opposite side; the decussating fibres are easily seen at the commissure. The third and fourth nerves pass to the orbit, where they supply the muscles; they arise between the medulla oblongata and the posterior cerebral tubercles. The trifacial nerve is very small, and has an extremely small supra-orbital branch. The eighth pair sends off a large glosso-pharyngeal to the tongue, along with a glossal branch of the pneumogastric. None of the other nerves display any points of interest.

On removing the upper part of one of the cerebral hemispheres, the large lateral ventricle is exhibited, closed internally from the median fissure by a thin plate, white on the ventricular, and grey on the internal aspect. This plate is connected with the opposite side by a narrow white band, easily torn, and situated far back, not far from the posterior cerebral tubercles; this seems to be similar to the band described by A. Müller as a rudimental corpus callosum. Each lateral ventricle consists of one part, and presents no cornua; it has two large grey masses on its floor—one large, anterior, the corpus striatum; another smaller, posterior, the optic thalamus, separated by a rudimentary tænia; overlapping the thalamus is a large fold of pia mater, which gains entrance posteriorly; this is the choroid plexus.

Posterior to the cerebral hemispheres appear the optic lobes or tubercles, which are covered by a layer of pia mater, enclosing a small oval pineal gland; these tubercles are hollow, and their cavities communicate with the lateral ventricles; in front of them passes a posterior commissure, which overlaps a large iter ad quartum ventriculum, or Sylvian aqueduct. The fourth ventricle is placed anterior and inferior to the cerebellum, and presents a very well marked calamus scriptorius. The spinal cord is fissured deeply in front and behind, and is enveloped in three membranes; each spinal nerve arises by two roots, of which the anterior is much the smaller; these pass separately through the dura mater, and unite outside the foramina of conjugation of the vertebræ, the posterior forming a ganglion which the anterior crosses, and the two roots are united immediately external; a branch of the sympathetic can be traced to each ganglion. The roots of the spinal nerves are not separated by a ligamentum denticulatum, but pass obliquely downward and outward, converging. The sympathetic is a small cord, passing along the spine, behind the aorta, and forming a solar plexus around the celiac axis.

The dissection of the extremities, both anterior and posterior, presents very many points of importance. Of late years, from the many interesting questions arising out of the subject of the origin of species, it has become a point of extreme importance that comparisons should be instituted between the development of similar structures in different animals, or diverse parts of the same animal, in order that we may arrive at correct ideas of homology. Now, in the ostrich we have a bird with terrestrial habits, and bearing a resemblance in the arrangements of its muscles to the mammalian class of animals; consequently it is of immense importance to have a correct idea of the position and nature of the muscles in his limbs. The branch of comparative anatomy which treats of muscles has been very much neglected of late, although there are as interesting considerations and as difficult problems involved in myology as in neurology or osteology.

The upper extremity, or wing, in the ostrich is very small, and perfectly incapable of flight; the prolonged humerus forms a very large portion of it. We find in this limb, however, the homologues of most of those muscles which are of use in those birds which are fitted for aerial locomotion. Coraco-brachialis forms an elongated fleshy muscle, arising from the outer third of the inferior edge of the coracoid bone, about two inches from its sternal articulation, it passes downwards and backwards, to be inserted into an oblique line on the inner side of the humerus, running downwards as far as about four inches below the head.

Biceps—a long, thin band—arises, by a distinct round tendon, from the coracoid bone, above the coraco-brachialis, and also by a distinct slip from that muscle. The fibres pass down straight, and are inserted by a tendon, which runs on the surface of the muscle for a short distance, into the tubercle on the inner side of the radius. This muscle is covered by a large cephalic vein, which runs from the outer side of the fore-arm to the inner side of the axilla, and terminates in the axillary vein.

Covering the outer surface of the foramen which exists between the coracoid and clavicular apophyses, is a triangular fleshy mass, with its base inwards. This muscle Professor Haughton has suggested, and apparently with good reason, to be the second pectoral of birds. Its fibres arise from the borders of this aperture, which it blocks up, and run outwards, becoming tendinous. The tendon passes in a groove over the head of the humerus, winding round a trochlear surface, to be inserted into the outer part of the great tuberosity. The function performed by this muscle evidently seems to be the elevation of the wing.

A hurried glance at the combined coracoid bone and clavicle cannot fail to suggest to the mind the appearance of the anterior part of an os innominatum, of which the former represents the ischiatic segment, and the latter, the pubis. The resemblance is extremely striking between the obturator foramen and this aperture in the bones of the scapular arch. May we not, then, consider the muscle closing this as the homotype of the obturator, in the anterior extremity, and thus conclude that the second pectoral in the fore is homotypical with the obturator externus in the hinder limb?

The subscapular muscle is divided into two portions: a superior, small, triangular, passes from the thoracic aspect of the coracoid bone, and upper part of the scapula, to be inserted into the inner tubercle, at the upper extremity of the humerus. The inferior portion arises from the posterior border of the scapula; the fibres run outwards, to be inserted by a twisted tendon below the last.

Deltoid—a triangular muscle—arises from the posterior border of the scapula, behind the humeral joint, by a flat tendon; it passes downwards and outwards, becoming fleshy, and is inserted into the ridge on the back of the humerus, as far down as to within three inches of the humero-cubital articulation.

Teres minor passes from the border of the blade of the scapula to the lowest point of the tubercle of the humerus. Extensor cubiti consists of two heads—one long, arising from the lower border of the scapula, between teres and deltoid; the second, or inner, from a ridge on the inner side of the humerus, as far down as an inch from the cubital joint; the two heads unite low down, and clothe the back of the humerus, and are inserted into the olecranon process of the ulna and fascia. Brachialis anticus arises from the lower half of the anterior surface of the humerus, passes under the pronator teres, to be inserted into an oblique ridge on the front of the ulna. Pronator teres runs from the internal condyle to the outer side of the radius, and passes over the radial artery.

Flexor digitorum communis arises from the anterior surface of the ulna, as far down as the lower extremity of that bone. The fibres end in small tendons, which are inserted into the second phalanx of all the digits.

Flexor carpi ulnaris passes from the inner condyle of the humerus, and the external part of the ulna, to the pisiform bone of the carpus. Supinator longus arises from a ridge above the outer condyle, and is inserted into the metacarpal bone of the thumb. The musculo-spiral nerve runs between this muscle and the brachialis anticus. Supinator brevis, beneath the last, runs from the outer condyle and external lateral ligament, to be inserted into the upper and outer part of the radius.

Extensor carpi radialis arises from the posterior surface of the radius, and runs to be inserted into the outer metacarpal bone.

Extensor digitorum communis passes from the external condyle into the last phalanges of the inner digits.

Extensor carpi ulnaris arises from the back of the outer condyle, and from the posterior surface of the ulna, for its whole length, and is inserted into the base of the outer metacarpal bone.

Indicator passes from the interosseous space, and the side of the ulna, and ends in a tendon which passes to the index finger. There are two interossei on the front of the metacarpal bones, and one on the dorsal aspect. A small abductor minimi digiti runs from the pisiform bone to the metacarpal bone of the third finger; and a still smaller abductor pollicis is attached to the outer bones of the carpus, and inserted into

the first phalanx. The small subclavian artery, about the size of a crow-quill, runs between the clavicle and first rib, and so passes down to nourish the upper extremity.

But, as the great characteristic endowment of the ostrich is its enormous power of running, we find that the muscles of its hinder limbs are those which are pre-eminent in point of development; these are exposed when the integument and the subjacent strong fascia are raised. Under the skin in the thigh, two large veins, an external, and an internal saphena, are traceable. Covering the whole of the posterior part of the hip and thigh, an enormous, triangular, flat, fleshy muscle is brought into view, which seems to consist of three parts—the upper third, or tensor vaginae femoris, the middle, or glutæus maximus; the inferior, or the depressor caudæ; the whole mass arises from the posterior edge of the ilium as far forwards as the commencement of the symphysis iliaca, and as far backwards as the side of the tail. The tensor vaginae femoris runs forwards, downwards, and outwards, converging to form a flat tendon, which passes over the anterior and external surface of the knee, where it unites with the anterior and lateral heads of the gastrocnemius, and partly is inserted into the head of the tibia along its anterior edge; the middle third, or glutæus, is inserted along with the last, and by a small musculo-tendinous slip unites with the vastus externus beneath. The depressor caudæ is hardly separable from the posterior border of the glutæus maximus, and is inserted into the lowest border of the tendons of the two upper portions.

On removing this enormous covering, the deeper muscles are exposed. Sartorius—a square, thick mass—arises from the outer side of the upper and anterior part of the ilium, and from the spines of the lumbar vertebrae; the fibres run downwards, forwards, and outwards, to be inserted into the side of the ligamentum patellæ, and the upper portion of the inner condyle of the tibia, and by a fascial expansion to the inner condyle of the femur. Glutæus medius—a triangular fan-shaped muscle—arising from a large space on the ilium, almost the whole of its external surface as far back as the acetabulum; the fibres converge, and run outwards to form a flat tendon, which is inserted into a pit on the upper and outer part of the great trochanter. The tendon passes over a bursa on the summit of the trochanter, and is attached to the origin of the vastus externus. The tendon of this muscle commences between two planes of muscular fibre. Glutæus minimus is a small pear-shaped muscle, arising from the upper and anterior portion of the ilium, superior and anterior to the acetabulum; its fibres converge, run backwards and outwards, and are inserted into the anterior ridge at the root of the great trochanter, posterior and inferior to the glutæus medius, and beneath a tendinous arch, formed by the origin of the vastus externus.

Opponens quadrato-femoris, or ilio-capsular, is a remarkable, well-marked, triangular, fleshy slip, arising from the ilium, anterior and inferior to glutæus medius, and superior and anterior to the glutæus minimus; the fibres run outwards, to be inserted into the same line as the last named muscle, and are united to it by a tendinous slip. The nature of the homo-

logy of this muscle does not appear at first sight very distinct; but it seems to agree with the muscle described by Harrison as the ilio-capsular, which rarely though occasionally occurs in man; and Dr. Wilson has suggested to me that it may be the homotype in the hinder limb of the *supraspinatus* in the upper extremity.

The glutæal artery, nerve, and vein, separate it from the *glutæus minimus*, and pass directly backwards to supply the muscles of the hip.

Iliacus is a triangular muscle, arising from the part of the iliac bone directly under the *glutæus medius*, and between the *glutæus minimus* and *opponens* muscles; it passes downwards and outwards to be inserted into the lower part of the neck of the femur and lesser trochanter, under the *cruræus*. The sciatic artery passes along with the sciatic nerve downwards to form the *poplitæal*, as the femoral artery is small, and only supplies the front of the thigh. The femoral vein and artery are separated by the *crural nerve*. *Cruræus*—a large oval muscle—arises tendinous and fleshy from the point of the great trochanter, and from the lower two-thirds of the anterior surface of the shaft of the femur; the fibres run forwards, and are inserted fleshy into the upper border of the patella on the inner side, and by a tendinous expansion into the anterior edge of the head of the tibia. *Vastus internus* muscle is composed of two parts, a superficial and a deeper seated; the former arises from the posterior and internal side of the femur, and from the *linea aspera* as far as to within two inches of the condyle; the second portion arises from the anterior and inner side of the bone, and is distinct from the former part, which overlaps it; the fibres of both muscles unite below to form a twisted tendon, which is inserted into the inner side of the head of the tibia, into the inner edge of the patella and the *ligamentum patellæ*.

Vastus externus is likewise divisible into two planes of fibres: the superficial, strong, oval, fleshy and tendinous, arises from the outer surface of the great trochanter, and from the upper part of the external division of the *linea aspera* and the rough surface at the upper and outer part of the femur for two inches and a half from the point of the trochanter; the fibres pass downwards and forwards to form a flat tendon which is inserted into the capsule of the knee, into the upper border of the patella, and by a tendinous expansion into the external side of the tubercle of the tibia; this tendon is connected to the origin of the *gastrocnemius*, and overlaps the tendons of the *glutæus medius* and *minimus*. The deeper plane of fibres arise from the ridge on the external surface of the femur, and forms a fan-shaped tendon, which is best developed along the posterior edge; a flat tendinous band passes from its deep surface to the outer edge of the tubercle of the tibia, running downwards, backwards, and outwards, along with the external lateral ligament, and connected to the outer origins of the flexor muscles; the rest of it is inserted, with the superficial part of the vastus, into the patella and tubercle of the tibia.

Rectus femoris arises fleshy from the anterior spine on the iliac bone, three inches in front of the acetabulum; it forms a strong oval belly, which ends in a flat tendon, which soon becomes rounded, and passes

over the anterior surface of the patella in a deep groove, which is directed downwards and outwards, underneath the outer head of the gastrocnemius; it then passes underneath the vastus externus and biceps tendons, becomes fleshy, and forms one of the origins of the flexor digitorum magnus: the length of this whole muscle, with its lower belly, is five feet.

On the back of the thigh are arranged the following muscles:—

Biceps—a large fleshy muscle—arises from all that part of the prolonged inferior spine of the ilium as far forward as the acetabulum, and separated from the inferior edge of the bone by the origin of the semimembranosus. In the female a small slip existed, attaching it to the posterior surface of the femur, which did not appear in the male. The fibres converge to a strong round tendon, which passes through a pulley, formed by the outer head of the gastrocnemius, and lined by a synovial membrane, and is inserted into the tubercle on the middle of the fibula: this muscle forms the external boundary of the popliteal space.

Semitendinosus—long, flat, and triangular—arises by two fleshy slips from the extremity of the posterior inferior spine of the ilium, and from the tuber ischii and the great sciatic ligament; the fibres converge, and are inserted into the upper and back part of the inner side of the tibia and tibial fascia; an accessory muscular slip connects this tendon with the insertion of the adductor magnus and the shaft of the femur.

Semimembranosus arises from the inferior border of the posterior inferior spine of the ilium, and from the border of the great sciatic ligament; the fibres are inserted into the lesser trochanter of the femur, and into a fascial line as far as the inner condyle. A slip from its origin in the female was attached to the side of the caudal vertebrae.

On the inner side of the thigh are arranged the following muscles:—

Obturator—a large, ovoidal, tendinous, and fleshy mass—arises from both the inner and outer surface of the rami of the pubis and ischium; communicating through the obturator foramen; all the fibres pass in the direction of the long axis of the pelvis, converging towards the lesser sciatic notch, which is almost entirely osseous, and is placed at the junction of the ischium and ilium; here it becomes tendinous, and passes outwards and a little backward to be inserted into the outer and upper part of the great trochanter. Its action is determined from the trochlear surface of the notch or foramen over which it winds, which is invested with synovial membrane; within the pelvis it lies along the border of the kidney.

Gemellus superior—flattish, small—arises from the anterior edge of the lesser sciatic notch, and is inserted by a thin flat tendon into the great trochanter in front of the obturator.

Gemellus inferior—smaller than the last—passes from the hinder margin of the lesser sciatic notch to the trochanter, behind the obturator tendon. These three muscles run in contact with the synovial membrane of the hip, as the capsule is very imperfect beneath.

Pectineus—a small flattish muscle—arises fleshy from the upper fifth of the ramus of the pubis, and from the pectineal eminence; the fibres run forwards, downwards, and outwards, becoming tendinous, to be in-

serted into the external part of the upper extremity of the tibia, immediately below the knee.

Gracilis arises by a flat tendon, about five inches long, from the ramus of the ischium and sciatic ligament; the fibres converge, and are inserted below the knee into the inner edge of the tibia, below the condyle, and into the fascia of the leg.

Adductor magnus arises fleshy from the posterior border of the ramus of the ischium, internal to the origin of the *semitendinosus*. The fibres pass downwards, forwards, and inwards, to be inserted into the upper part of the condyloid pit of the femur.

Gastrocnemius—an enormously large fleshy mass, investing the back, front, and sides of the leg—arises by four heads: one from the external side of the patella and *ligamentum patellæ*, as far down as the tubercle of the tibia; the second springs from the external condyle of the femur and external lateral ligament; a tendinous pulley passes across from the upper part of the outer condyle, looping round to the external head, and around this winds the biceps; the third head is attached to the deep pit over the internal condyle; and the fourth, or external or largest head, arises from the anterior and lateral aspects of the tubercle of the tibia, the *ligamentum patellæ*, and both patellæ, also from the fibula by fascia, for its whole length. All these masses unite, and end in a large flat strong tendon, nearly two inches wide, which is inserted into the edges of the metatarsal bone as far down as its lower third; this tendon winds over the trochlear surface at the end of the tibia, forming a sheath for the deeper tendons on the back of the metatarsus.

Tibialis anticus—long and thick—arises by two heads: one internal fleshy, from the outer surface of the groove on the outside of the tubercle of the tibia; the other by a very strong round tendon from the articular surface of the outer condyle; this soon becomes fleshy, three inches below its origin, and unites with the former. The tendon passes to the ankle under a distinct annular ligament, and splits into two parts for the passage of the *extensor unguis*, each part being inserted into the lateral ridges on the anterior aspect of the metatarsal bone. The deep origin of this muscle is sheathed by the synovial membrane of the knee joint, which it strengthens very considerably. The anterior tibial vessels and nerves pass through the same sheath of the annular ligament, and the anterior tibial nerve passes through the splitting of the tendon.

Extensor digitorum communis arises fleshy from the sharp ridge of the anterior aspect of the tibia to five inches below the tubercle, and from the bony surface external to it; the fibres run to a strong round tendon, which passes in front of the ankle, internal to the last, and separated from it by a strong second annular ligament which binds it down; the tendon passes downwards, and ends in a flat expansion, which, at the metatarso-phalangeal joint, sends a slip into the proximal extremity of each of the phalanges.

Extensor unguis—a very delicate muscle—commences by a thin round tendon at the front of the trochlea, at the lower extremity of the tibia, close to the internal malleolus; this tendon passes through the insertion

of the *tibialis anticus*, and ends in an extremely fine muscle, lying in a groove in front of the tibia; this belly ends in a tendon seventeen inches long, which passes under the extensor of the outer toe along the tendon of the last named, to be inserted into the last phalanx of the inner toe. The action of extension or elevation of the last phalanx and nail is facilitated by the prolongation upwards of the synovial membrane on the dorsum of the third phalanx.

Flexor digiti interni, arises by two heads—one from the outside of the tubercle of the tibia, the other from the external lateral ligament of the knee, separated from each other by the rectus tendon; these unite, and end in a tendon which passes in a groove in the sheath behind the tibio-metatarsal joint, and is inserted by two slips into the base of the third phalanx of the inner toe; the deep flexor perforates its last portion, and the superficial flexor is perforated by it; a sesamoid bone exists in the back of the metatarso-phalangeal joint, to which the retinacula are attached.

Flexor digiti magnus begins also by two heads—the upper, fleshy, from a deep pit above the condyles of the femur, in common with several other muscles; the lower from the tendon of the rectus, and external lateral ligament, and from the back of the fibula; these heads unite to form two fleshy bellies, detached above, but united below and behind the ankle by the junction of their tendons, which pass in the sheath behind the joint, and here the united tendons are perforated by the *flexor externi digiti* tendon. In passing down to the foot, the *flexor digitorum* tendon receives a slip from that of the *gastrocnemius*, at the metatarso-phalangeal joint, and sends a slip into the sesamoid tubercle of the former tendon; the tendon forms a sheath on the plantar surface of the toe, and is inserted into the base of the second phalanx by two slips.

Flexor profundus digitorum is the deepest tendon in the foot; it commences by two distinct fleshy masses—one from the pit in the back of the condyle of the femur, and the other from the posterior aspect of the tibia for its upper two-thirds; the tendons of the two are separate as far as near the metatarso-phalangeal joint, where they unite, and are inserted into the last phalanx of the great toe, and by a fine slip into the last phalanx of the outer toe.

Flexor perforatus externi digiti arises by two heads—one from the pit in the back of the femur by a common muscular origin; and the second from the external lateral ligament of the knee; the tendon passes down the common groove behind the metatarso-phalangeal joint, where it ends by three slips—one into the proximal phalanx of the lower toe; the two others are separated by the slip of the *flexor profundus*; and the outer is inserted into the base of the second phalanx, in common with the fore-mentioned extensor slip of the little toe; the third passes to the base of the third phalanx.

Interosseus—an extremely delicate muscle—arises from the whole length of the interosseus groove, the two heads being separated at their origin by the interosseus artery piercing the bone; the tendon is flat

and ribbonlike, and passes over the spur on the outer condyle of the metatarsus, and is inserted into the outer side of the base of the first phalanx of the outer toe; a few oblique fibres on the opposite side of the bone represent the dorsal interosseus muscle.

Popliteus—a small, triangular muscle, having the base at the tibia, and the apex upwards and outwards—arises tendinous from the head of the fibula; the fibres pass downwards and inwards, to be inserted into the upper part of the tibia, as far as the internal lateral ligament. The popliteal vein separates it from the back of the fibula, and the artery and nerve lie superficial.

The articulations of the lower extremity present many points of mechanical importance. The first, or the hip, is an enarthrosis, surrounded by a capsule, loose, expanding inferiorly; the synovial membrane spreads over the great trochanter; a strong transverse band passes from the border of the lesser sciatic notch to the upper and posterior edge of the acetabulum, under which the articular vessels pass to the joint. An extremely strong ligamentum teres passes downwards, outwards, and forwards, from the lower border of the cotyloid cavity, and is inserted into the upper part of a depression on the head of the femur, near which it is cylindrical; at its origin it is flattish and expanded; a cotyloid ligament protects the superior and anterior edge of the joint; thick and cartilaginous above, thin and membranous below and in front. The bottom of the cavity is separated from the air cells by a membrane consisting of fibres running downwards and forwards, and some radiating.

The knee is a ginglymus, formed by the femur, patella, tibia, and fibula.

The ligaments are: internal lateral, coffin-shaped, from the inner condyle, running downwards and backwards to the inner side of the popliteus. The most posterior fibres arise entirely from the internal semilunar cartilage, which they assist in fixing. The patella is large, flattish, made of two parts, the external surface larger, the inner smaller and more cartilaginous; the quadriceps is inserted into its upper border, and from its lower edge passes off on its inner side a large flat ligament, whose fibres, stretched over the Haversian masses of fat, converge, to be inserted into the upper edge of the tibia on the inner edge of the tubercle.

From the lower border of the true patella to the upper surface of the tubercle of the tibia extends a long, prismatic, bony column, united above to the patella by strong fibres, and resting below on the tubercle, with which it articulates by a strong ligament and a small synovial membrane. This seems to be properly an ossified ligamentum patellæ rather than a true second patella.

On the outer side of the joint there is a superficial ligament, which forms an origin for the long flexor muscles, and is attached above to the front of the outer condyle of the femur, and below is united to the origin of the before-named muscles. Some parts of it are inserted into the semilunar cartilage, and others pass downward, and slightly backward,

to be inserted into a ridge on the side of the fibula. Beneath this a deeper ligament runs from the posterior portion of the outer condyle, downwards and backwards, to the anterior aspect of the head of the fibula; and the most anterior fibres are attached to the external semilunar cartilage. A synovial ligament, composed of synovial membrane, and containing a few blood-vessels, runs from the Haversian mass of fat to the front of the intercondyloid notch of the femur. Alar ligaments are two thin folds of the same structure, which lie on either side of the patella, and are inserted into the upper part of the middle ridge on that bone. Their free borders are directed inwards, towards the mesial line of the joint. The outer is much less distinct than the inner. The anterior crucial ligament arises from the inner side of the outer condyle, far back. It passes downwards, forwards, and inwards; and is inserted by two slips into the anterior cornu of the internal semilunar cartilage, and into the inner and anterior border of the internal condyle of the tibia. The posterior crucial runs from the posterior and superior part of the deep pit between the condyles of the femur, downwards and forwards, to be inserted into the spine of the tibia on the outer side of the posterior cornu of the internal semicircular cartilage, sending a small slip into the inner edge of the outer cartilage. There are two of these latter bodies—one semilunar, internal, with a thick outer rim, attached by its anterior cornu to the head of the tibia and transverse ligament, and by its posterior to the back of the spine of the tibia, and by a strong slip that passes behind the posterior crucial into the inner surface of the outer condyle of the femur. The external is larger, and forms a complete deep cup for the outer condyle. Its lower surface is irregular, to suit the upper part of the tibia and fibula, especially in front; it is connected to the internal by a broad and flat transverse ligament in front of the anterior crucial, and behind the Haversian mass of fat. Beneath the transverse ligament lies another broad flat band, from the front of the internal condyle of the tibia to the lower surface of the external semilunar cartilage. This body is connected to the anterior edge of the fibula by two small flat bands, one above the other, the lower being the larger, and both running backwards and outwards; behind, it is connected to the posterior edge of the head of the fibula by a small transverse slip.

The superior tibio-peronæal ligament passes from the outer and anterior part of the head of the tibia to the inner aspect of the head of the fibula, underneath the outer semilunar cartilage. An inferior ligament unites these bones below.

The chief agent in the joint to limit rotation consists of the strong tendon of the long extensors, which, arising from the external condyle of the femur, passes along the outer side of the tibial tubercle through the joint, enclosed in a fold of synovial membrane. The origin of the flexors externally likewise is a strong protective to the articulation. If the joint be suspended, it naturally rotates outwards. The anterior crucial is far stronger than the posterior. The strong prismatic ossified ligamentum patellæ anteriorly limits flexion forwards. This is con-

nected above to the true patella, is about two inches and a half long, and below is articulated with the upper surface of the tubercle of the tibia, a synovial sac intervening between the two bones. The Haversian gland is large, and contains cells of fluid fat.

The tibio-metatarsal joint is also ginglymoid in structure, and the two bones are united by the following ligaments:—

Internal lateral arises from the upper and back part of the prominence on the inner side of the lower end of the tibia. It passes downwards and forwards, to be inserted into the internal lateral ridge on the metatarsus for about four inches. The deep internal lateral is anterior to the last, and passes from the deep pit on the inner side of the tibia, downwards and forwards, to the inner edge of the front of the metatarsus. This ligament is twisted in the extended position, and straightened as the limb becomes flexed. As this band slips over a prominent ridge on the edge of the inner side of the tibia, it gives a spring to the joint. The superficial external lateral ligament runs from the upper and anterior part of the outer side of the tibia, downwards and backwards, expanding, to be inserted into the posterior part of the outer edge of the metatarsus. The deep external lateral ligament arises in a deep pit on the outer side of the external malleolus, an inch below the last. It passes downwards and forwards, expanding, to be attached to the anterior part of the metatarsus. A distinct posterior ligament exists, covered by the great tendons lying in their sheath, which is attached to the upper border of the metatarsus by strong fibrous slips. In front, a convex fibrocartilaginous anterior ligament covers the joint, running from the tibia to the metatarsus, fibrous on either side, and cartilaginous in the centre, where it sends septa in between the various tendons.

Posteriorly and externally a rhomboidal inter-articular cartilage is observable, which is retained in its place by two bands—one anterior, passing forwards, semilunar in shape, and attached to the front of the metatarsus; another running backwards, shorter, and attached to the posterior part of the notch between the condyles of the bone. This acts in preventing over-extension of the joint, and in increasing its elasticity.

Respecting the osseous anatomy of the ostrich there are no novel points of importance observable in either of our specimens. In the pelvic arch the principal characteristic seems to be the prolongation into lines of those parts which in most other animals are represented by points, as is exemplified in the posterior inferior iliac spine, which is described in the Appendix to "Todd's Cyclopædia" as a separate sacro-iliac element; also in the elongation of the rami of the ischium and pubis. The lesser sciatic notch is also closed below and behind by a bony connecting band between the ischiatic spine and tuberosity, so as to be converted into a foramen through which the obturator tendon winds.